

These results will, I think, be considered sufficiently remarkable by metallurgists who have been accustomed to deal with castings of standard silver. It must not be supposed, however, that liquation has been entirely prevented; *it has, however, practically disappeared.*

The excellent results now submitted to the Society have been obtained by limiting the possibilities of re-arrangement as much as may be, and by ensuring that the conditions of cooling shall be as uniform as possible. The need of obtaining uniform alloys is met with in other branches of industry than those which involve the use of silver-copper alloys, so that the conclusions to which the present experiments point are somewhat far-reaching.

- V. "A Contribution to the Study of Descending Degenerations in the Brain and Spinal Cord, and of the Seat of Origin and Paths of Conduction of the Fits in Absinthe Epilepsy." By RUPERT BOYCE, M.B., Assistant Professor of Pathology, University College, London. Communicated by Professor V. HORSLEY, F.R.S. Received February 8, 1894.

(From the Pathological Laboratory of University College, London.)

(Abstract.)

For the purposes of this research, the following are the experiments which have been performed in the cat:—

I. *Lesions after which Animal was Kept Alive.*

1. Removal of one complete cerebral hemisphere in 40 cats.
2. Removal of motor area only in 4 cats.
3. Division of the crus cerebri in 2 cats.
4. Removal of a lobe of the cerebellum in 10 cats.
5. Hemisection of the spinal cord in 4 cats.
6. Complete section of the spinal cord in 2 cats.

II. *Lesions after which Animals were not Kept Alive for any Length of Time.*

1. The preceding operations.
2. Removal of both cerebral hemispheres.
3. Removal of the cerebellum.
4. Removal of one cerebral hemisphere and opposite lobe of cerebellum and *vice versa*.
5. Removal of one hemisphere and division of opposite half of the spinal cord.

Where the animals have been kept alive, the symptoms during life and the anatomical changes found after death have been investigated, and in all cases the results of absinthe stimulation have been recorded by the graphic method.

In order to enable a clearer comparison to be made between the various results obtained by the experimental and anatomical methods, the paper is divided into—

- I. The anatomical changes.
- II. Behaviour of the animal during life.
- III. Results of absinthe stimulation.
- IV. Conclusions.

PART I.—*Anatomical Changes.*

The investigations of the degenerations have been made in every instance by the Marchi method upon animals which have been kept alive from a few days to three months.

Removal of one Cerebral Hemisphere (Left), or complete Section of the Left Crus Cerebri flush with the Tentorium.

The results of these lesions as regards the descending degenerations are identical.

They show that in the higher bulbo-spinal segments, from the 3rd nerve downwards, there exist long descending internuncial fibres, which are grouped anteriorly and laterally as in the spinal cord; in other words, that the anterior, antero-lateral, and lateral columns of the cord can be traced from the level of the superior corpora quadrigemina.

Anterior Columnar Fibres.—These fibres begin to group at the level of the uppermost part of the 3rd nerve against the anterior and inner aspect of the grey matter of the aqueduct of Sylvius; they constitute the commencement of the posterior-longitudinal bundle. The degenerate fibres are absolutely limited to the side of the lesion; they occupy, for the most part, the inner portion of the posterior-longitudinal bundle, and they can be traced to the end of the cervical spinal cord. The higher the lesion the fewer are the number of degenerate fibres in the post.-longitudinal bundles; if the lesion extends much below the 3rd nerve, the degeneration of the post.-longitudinal bundle is very complete. New fibres are continually being added to the post.-longitudinal bundle in its passage through the bulbar segments, the degenerate fibres in consequence moving more anteriorly. In the spinal cord the degenerate fibres are scattered through the middle and post.-thirds of the anterior column on its inner aspect and closely simulate a direct pyramidal tract.

Antero-lateral Columnar Fibres.—Meynert's fibres (fountain decussation) pass from the side of the lesion across the raphe immediately ventral to the post.-longitudinal bundles, and turn vertically down, lying in the raphe in front of the post.-longitudinal bundles. The fibres can be traced into the antero-lateral column of the cord as far as the lower cervical region. In their descent they move slightly forwards, but they are always more anterior than the fibres of the post.-longitudinal bundles. The degeneration method shows that Meynert's fibres arise in a focus close to the point of commencement of the descending root of the 5th, on a level *with the roots* of the 3rd nerves. The vast majority of the fibres decussate completely; the decussation is a very horizontal one.

Lateral Columnar Fibres.—In the highest segments these are derived from fibres, which decussate in front of the preceding group, and originate from a slightly higher level in the tegmentum; they probably correspond to Forel's decussating fountain fibres. In the mesencephalon they occupy a position in front of and slightly external to the antero-lateral columnar fibres; lower down they are more laterally situated, and in the pons and medulla form a well defined group, immediately in front of the ascending root of the 5th and the substantia gelatinosa, and dorsal to the nucleus lateralis; they are traversed by the root of the 7th, and are bounded externally by trapezoid, and ascending cerebellar fibres. They are internal to the lemniscus and quite distinct from it; they can be traced to the upper lumbar spinal cord. In the spinal cord they occupy a position immediately in front and to the outer side of the pyramidal tract; they are readily distinguished from the latter by their large size.

Degeneration of Descending Root of 5th.—The Marchi method shows that this root is invariably degenerate upon the side of the lesion. It arises in the lateral aspect of the Sylvian grey matter at about the level of the upper oculo-motor nucleus, descends to meet the ascending root, and passes out without interruption.

Pyramidal System.—The degeneration is confined exclusively to the pyramid on the side of the lesion, and the degeneration appears complete.

There is a slight *bifurcation* at the decussation, a small group of fibres passing back to the lateral tract on the same side. There is thus a *direct lateral pyramidal tract*, but there is no *anterior* direct pyramidal tract.

The decussation of the pyramid is not confined to the cervical region; degenerate fibres leave the pyramidal system from the internal capsule, the crusta, and from the pyramid in the medulla. A large group passes through the thalamus and beneath the corpora quadrigemina, many of the fibres crossing over in the roof of the aqueduct. A considerable number of degenerate fibres pass back to

the quadrigeminal region from the outer and dorsal part of the crusta.

In the *posterior commissure*, *pineal commissure*, and *corpus callosum* there are numerous degenerate fibres.

When the motor area or anterior third of the brain is removed, the degeneration is confined to the pyramidal system, the contrast with the results of hemisection of the mesencephalon being, therefore, very striking.

Comparing hemisection of the mesencephalon with hemisection of the cord, the difference, as regards the internuncial fibres, is the greater amount of decussation in the mesencephalon than in the cord. The internuncial fibres are conspicuous by their large size.

Comparison with ascending degenerations at the various levels shows that the descending tracts described above are distinct from the ascending.

Lesion of the Cerebellum.—When one lobe of the cerebellum is removed there is degeneration of the superior cerebellar peduncle. I have found no evidence of the descending columnar degeneration described by Marchi.

PART II.—*Symptoms of Animals during Life.*

Comparing the relationship between the extent of the degenerations and the symptoms, it is found that—

Removal of the motor area entails degeneration of the pyramid alone, and a temporary paresis; the animal appearing, after a short time, quite like the normal.

Removal of a cerebral hemisphere or hemisection in the quadrigeminal region gives rise to degeneration of the pyramidal and internuncial systems and fibres. The symptoms are more pronounced; sensation is much altered; there is great difficulty of feeding.

Hemisection of the cervical spinal cord produces extensive degeneration of the anterior and lateral columns of the cord. There is at first hemiplegia, the vasomotor disturbance is much greater, and the sensory and motor paresis lasts longer.

Removal of a lobe of the cerebellum does not appear to be accompanied by descending columnar degeneration; the symptoms may be very slight, or there may be incoordination and sensory and motor weakness upon the side of the lesion. The manifestation of the motor weakness differs from that seen in the cats, in which the pyramid is degenerate. There is no wrist drop in the cerebellar cat. The weakness in the case of the pyramidal cats is uncomplicated; on the contrary, that in the cerebellar cat is intimately bound up with complex phenomena of incoordination.

The evidence would tend to show that the weakness in the two cases is due to different causes.

PART III.—*Results of Absinthe Stimulation.*

The absinthe has been injected either immediately after the operation or after complete recovery. There are, therefore, two categories of experiments, viz., “immediate” and “remote”; but, as a rule, the difference between the average results in both cases is slight. The fit was registered by spring myographs attached to the extensor tendons of the fore paws.

1. *Removal of one Cerebral Hemisphere, or Hemisection of the Mesencephalon, and Immediate or Remote Absinthe Stimulation.*

Result.—There are bilateral fits. On the paretic side the initial fit may be much smaller than on the left side; in the subsequent fits, tonus is more marked than clonus; the final clonic contractions are less numerous.

2. *Removal of Left Motor Area; Immediate and Remote Stimulation.*

Result.—The fits upon the right and left sides more closely resemble one another; there is considerable clonus upon the “paretic” side as well as upon the normal.

3. *Removal of both Hemispheres.*

Result.—Immediate removal of the hemispheres arrests the fits; a slight respiratory response can, however, be elicited. Where one hemisphere has been first removed, and after recovery the remaining hemisphere and absinthe has been given, contractions have been obtained, occurring at regular intervals and equal upon both sides; in one case the contraction was most marked upon the side corresponding to the hemisphere first removed. Removal of both hemispheres and stimulation upon the second day was followed by two strong fits, made up of a series of contractions following one another fairly rapidly, but not so rapidly as in the clonus when a hemisphere is present.

Where both motor areas have been removed in succession, regular tonic and clonic bilateral responses have been obtained; the rhythm of the clonus is much slower than when the cortex is intact.

4. *Removal of Cerebellum and Immediate Absinthe Stimulation. Removal of one Lobe of the Cerebellum. Removal of Left Hemisphere and Left Lobe of the Cerebellum. Removal of Left Hemisphere and Right Lobe of the Cerebellum and v. v. Immediate and Remote Absinthe Stimulation.*

Result.—Removal of the whole cerebellum does not stop the fits, nor impart to them any special character. Removal of one lobe of the cerebellum appears to have very little effect upon the fits. Where, in addition the opposite cerebral hemisphere is removed, the fits appear similar to those seen when the hemisphere alone is removed.

5. *Removal of Left Hemisphere and Subsequent Section of the Right and Left Halves of the Cervical Spinal Cord.*

Result.—Conduction abolished on the side of section.

6. *Hemisection of the Upper Cervical Spinal Cord and Absinthe Stimulation.*

Result.—In cats which have partially recovered from the effects of the hemisection, absinthe produces a response upon the side which was divided.

7. *Complete Section in the Dorsal Region.*

Result.—In two cases of complete recovery (complete paralysis of the hind quarters remaining), absinthe did not elicit a response from the distal segment of the cord; the experiments, however, require repeating.

PART IV.—*Conclusions.*

The formation of the descending system of the anterior, antero-lateral, and lateral columns can be seen in the mesencephalon.

There is a marked decussation of the lateral and antero-lateral column fibres in the mesencephalon. The anterior column fibres (post.-longitudinal bundle) appear to be direct fibres. Decussation is, however, not limited to this region; it occurs in the spinal cord, and probably throughout the bulbo-spinal system.

Decussation of the pyramidal system is not limited to the cervical region; it occurs in the higher segments. As in the preceding system so in this, there is a direct path—the direct lateral pyramidal tract, and there is evidence of direct fibres in the higher segments.

There is bilateral distribution of both systems of fibres, but there is no evidence whatever of recrossed fibres.

No fibres get into the opposite pyramid by way of the corpus callosum.

Stimulation with absinthe shows that the bulbo-spinal centres (including the cerebellum) alone, can produce a series of clonic fits, differing from the cortical in the much slower rhythm of the contractions. But from the complete section of the cord experiments it seems improbable that the cord alone can be excited by absinthe.

Immediate hemisection of the cord prevents the absinthe fit on that side; but after recovery a modified fit results upon the side of the lesion, in spite of the fact that the direct lateral and crossed pyramidal tracts are completely degenerate, as well as the internuncial fibres in the anterior and lateral columns.

When one hemisphere is removed or a complete hemisection made in the quadrigeminal region, there are bilateral fits, in spite of the fact that one pyramidal system is completely degenerate. The fits are modified upon the side opposite to the lesion, the clonus being less marked, and the first fit being absent or very small.

If, in the last two cases, a hemisection is made upon the side of the degenerate pyramid, it instantly arrests the fits upon that side, the section interrupting the sound direct pyramidal tract.

I therefore conclude that the maximal effect of absinthe is produced when the motor area is present, and that the impulses generated there are distributed by the pyramidal system in the way described, the maximal effect crossing to the opposite side, the question of unilaterality or bilaterality being one of degree as shown by the differences between the initial and subsequent fits, and as borne out by the relative sizes of the crossed and uncrossed tracts.

The epilepsy due to absinthe indicates that there are probably very many epileptiform attacks in man which are toxic.

VI. "A Research into the Elasticity of the Living Brain, and the Conditions governing the Recovery of the Brain after Compression for Short Periods." By A. G. LEVY, M.B. (London). Communicated by Professor HORSLEY, F.R.S. Received February 21, 1894.

(From the Laboratory of the Pathological Department of University College, London.)

(Abstract.)

(Towards the expenses of this research a grant was made by the British Medical Association at the recommendation of the Scientific Grants Committee.)

In view of the great frequency of compression of the brain as a pathological condition, it seems very advisable to attempt to obtain